

Sepax CNT SEC Phases

Pioneering in the Separation of Nanotubes

The Best Quality Products

General Description

Utilizing proprietary surface technologies, the Sepax CNT SEC phases are made of specially coated porous silica materials. The silica support has high purity and enhanced mechanical stability. The Sepax CNT SEC phases have been innovatively and specially designed to ensure highest resolution and maximum recovery for the separation of nanotubes, such as carbon nanotubes, and nanorods. The Sepax proprietary surface technology allows extremely high column-to-column reproducibility and provides exceptional phase stability. The uniform, spherical particles of the Sepax CNT SEC phases have a nominal pore size at 300 Å, 500 Å, 1,000 Å, and 2,000 Å with the pore volume at *ca.* 1.0 mL/g. The Sepax CNT SEC phases are packed with a proprietary slurry technique to achieve uniform and stable packing bed density for maximum column efficiency. Typical applications for the Sepax CNT SEC columns are the separations of nanotubes in aqueous buffer solutions as well as normal organic solvents, such as acetonitrile, methanol and THF.

Characteristics

- High efficiency and resolution
- Extremely stable in high salt solution
- Great batch-to-batch reproducibility
- High temperature resistance (up to 100 °C)
- High recovery and easy for scale-up
- Wide pH application range 2 – 8.5

Applications

- Separation of carbon nanotubes by length
- Separation of nanorods by length
- Separation of nanoparticles by diameter
- Analytical, semi-preparative, and preparative separation

Carbon nanotubes are manufactured with random diameter from a few of nanometers to *ca* 1,000 nm and variable diameters. An uniform length of carbon nanotubes is crucial for their applications in electronics. Figure 1 shows an AFM image of a single-walled carbon nanotube wrapped with DNA molecules. The DNA wrapped CNT is

soluble in water so that the separation can be effectively achieved.

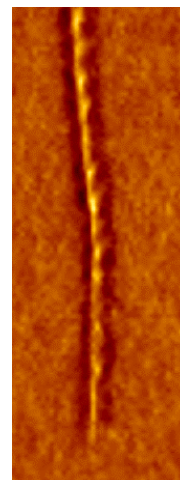


Figure 1. An AFM image of a DNA wrapped single-walled carbon nanotubes. (Courtesy of Dr. Ming Zheng, Du Pont)

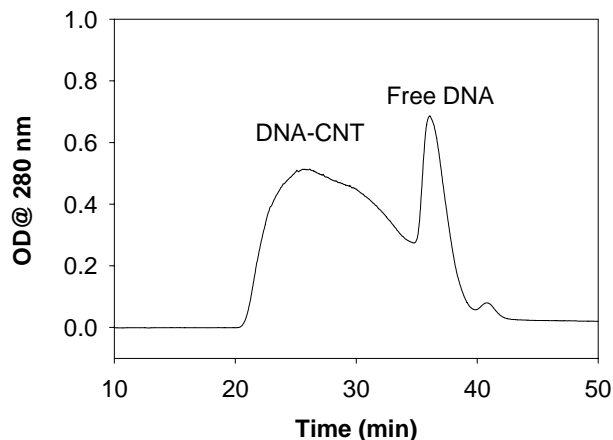


Figure 2. Separation of DNA wrapped carbon nanotubes by a combination of Sepax CNT SEC-300, CNT SEC-1000, and CNT SEC-2000 columns (4.6x250 mm, 5µm). Mobile phase: 0.1 M Tris + 0.2 M NaCl, pH 7.0. Flow rate: 0.25 mL/min. (Courtesy of Huang et al, *Anal. Chem.* **2005**, 77, 6225)

Figure 2 shows the elution profile of DNA wrapped carbon nanotubes by running three consecutive Sepax CNT SEC-300, CNT SEC-1000, and CNT SEC-2000 columns. Each of the fractions was collected for analyzing the length profile. Figure 3 shows AFM images of three fractions: f21, f25 and f30 carbon nanotubes. The average length for f21, f25, and f30 is 600, 200, and 100 nm, separately. The AFM images indicated fairly uniform length for each of the fractions.

F21: L = 527±32 nm

F25: L = 192±19 nm

F30: L = 75±8 nm

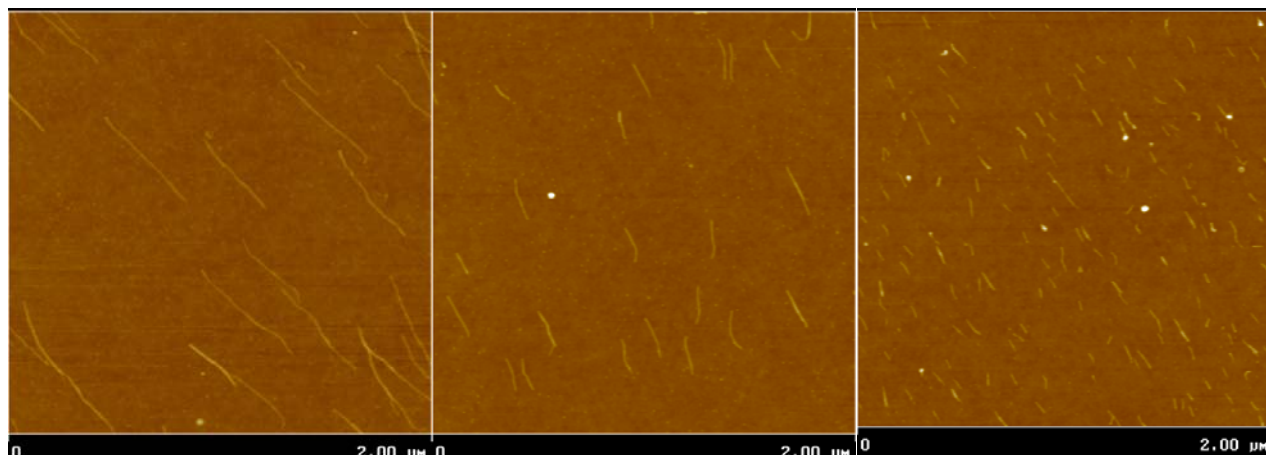


Figure 3. Uniform length separation of DNA wrapped carbon nanotubes by a running consecutive Sepax CNT SEC-300, CNT SEC-1000, and CNT SEC-2000 columns (4.6x250 mm, 5μm). (Courtesy of Dr. Ming Zheng, Du Pont)

CNT SEC Technical Specifications

Product	Pore Size	Particle Size	MW Range (Dalton)	pH	Temperature limitation	Applications
CNT SEC-300	300 Å	5, 10 μm	Length 1-100 nm Diameter 1-5 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-500	500 Å	5, 10 μm	Length 25-250 nm Diameter 1-10 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-1000	1,000 Å	5, 10 μm	Length 100-500 nm Diameter 1-25 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-2000	2,000 Å	5, 10 μm	Length 300-1000 nm Diameter 1-50 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles

Samples and Mobile Phases

To avoid clogging the column, all samples and solvents including buffers should be filtered through 0.45 μm or 0.2 μm filters before use. The CNT SEC columns are compatible with aqueous mobile phase, organic solvent, or a mixture of organic and water, such as methanol or acetonitrile and water. **The CNT SEC columns are incompatible with cationic species, such as cationic detergents, polymers and proteins.** Always degas the mobile phase. A simple way for degassing is to sonicate it for 5 minutes under water pumped vacuum.

Sepax CNT SEC Products

CNT SEC	ID x Length (mm x mm)	Particle size	Pore size	P/N
300	4.6x250	5 μm	300Å	205300-4625
	7.8x300	5 μm	300 Å	205300-7830
	21.2x250	5 μm	300Å	205300-21225
500	4.6x250	5 μm	500Å	205500-4625
	7.8x300	5 μm	500 Å	205500-7830
	21.2x250	5 μm	500Å	205500-21225
1000	4.6x250	5 μm	1000Å	211000-4625
	7.8x300	5 μm	1000 Å	211000-7830
	21.2x250	5 μm	1000Å	211000-21225
2000	4.6x250	5 μm	2000Å	212000-4625
	7.8x300	5 μm	2000 Å	212000-7830
	21.2x250	5 μm	2000Å	212000-21225

Ordering Information*

Sepax CNT SEC-300 phases

Particle Size	Length x ID (mm x mm)	Pore size	P/N	Price
5µm	250x21.2	300Å	205300-21225	\$2790.00
5µm	150x21.2	300Å	205300-21215	\$1995.00
5µm	100x21.2	300Å	205300-21210	\$1350.00
5µm	50x21.2	300Å	205300-21205	\$690.00
(Guard column)				
5µm	300x10	300Å	205300-10030	\$1750.00
5µm	250x10	300Å	205300-10025	\$1550.00
5µm	150x10	300Å	205300-10015	\$1150.00
5µm	100x10	300Å	205300-10010	\$895.00
5µm	50x10	300Å	205300-10005	\$575.00
(Guard column)				
5µm	300x7.8	300Å	205300-7830	\$1095.00
5µm	250x7.8	300Å	205300-7825	\$950.00
5µm	150x7.8	300Å	205300-7815	\$785.00
5µm	50x7.8	300Å	205300-7805	\$375.00
(Guard column)				
5µm	300x4.6	300Å	205300-4630	\$950.00
5µm	250x4.6	300Å	205300-4625	\$850.00
5µm	50x4.6	300Å	205300-4605	\$365.00
5µm	30x4.6	300Å	205300-4603	\$275.00
(Guard column)				

Sepax CNT SEC-500 phases

Particle Size	Length x ID (mm x mm)	Pore size	P/N	Price
5µm	250x21.2	500Å	205500-21225	\$2790.00
5µm	150x21.2	500Å	205500-21215	\$1995.00
5µm	100x21.2	500Å	205500-21210	\$1350.00
5µm	50x21.2	500Å	205500-21205	\$690.00
(Guard column)				
5µm	300x10	500Å	205500-10030	\$1750.00
5µm	250x10	500Å	205500-10025	\$1550.00
5µm	150x10	500Å	205500-10015	\$1150.00
5µm	100x10	500Å	205500-10010	\$895.00
5µm	50x10	500Å	205500-10005	\$575.00
(Guard column)				
5µm	300x7.8	500Å	205500-7830	\$1095.00
5µm	250x7.8	500Å	205500-7825	\$950.00
5µm	150x7.8	500Å	205500-7815	\$785.00
5µm	50x7.8	500Å	205500-7805	\$375.00
(Guard column)				
5µm	300x4.6	500Å	205500-4630	\$950.00
5µm	250x4.6	500Å	205500-4625	\$850.00
5µm	50x4.6	500Å	205500-4605	\$365.00
5µm	30x4.6	500Å	205500-4603	\$275.00
(Guard column)				

Sepax CNT SEC-1000 phases

Particle Size	Length x ID (mm x mm)	Pore size	P/N	Price
5µm	250x21.2	1000Å	211000-21225	\$2950.00
5µm	150x21.2	1000Å	211000-21215	\$2250.00
5µm	100x21.2	1000Å	211000-21210	\$1750.00
5µm	50x21.2	1000Å	211000-21205	\$950.00
	(Guard column)			
5µm	300x10	1000Å	211000-10030	\$1750.00
5µm	250x10	1000Å	211000-10025	\$1550.00
5µm	150x10	1000Å	211000-10015	\$1150.00
5µm	100x10	1000Å	211000-10010	\$895.00
5µm	50x10	1000Å	211000-10005	\$575.00
	(Guard column)			
5µm	300x7.8	1000Å	211000-7830	\$1095.00
5µm	250x7.8	1000Å	211000-7825	\$950.00
5µm	150x7.8	1000Å	211000-7815	\$785.00
5µm	50x7.8	1000Å	211000-7805	\$375.00
	(Guard column)			
5µm	300x4.6	1000Å	211000-4630	\$950.00
5µm	250x4.6	1000Å	211000-4625	\$850.00
5µm	50x4.6	1000Å	211000-4605	\$395.00
5µm	30x4.6	1000Å	211000-4603	\$295.00
	(Guard column)			

Sepax CNT SEC-2000 phases

Particle Size	Length x ID (mm x mm)	Pore size	P/N	Price
5µm	250x21.2	2000Å	212000-21225	\$3350.00
5µm	150x21.2	2000Å	212000-21215	\$2550.00
5µm	100x21.2	2000Å	212000-21210	\$1950.00
5µm	50x21.2	2000Å	212000-21205	\$1050.00
	(Guard column)			
5µm	300x10	2000Å	212000-10030	\$1950.00
5µm	250x10	2000Å	212000-10025	\$1780.00
5µm	150x10	2000Å	212000-10015	\$1320.00
5µm	100x10	2000Å	212000-10010	\$1030.00
5µm	50x10	2000Å	212000-10005	\$660.00
	(Guard column)			
5µm	300x7.8	2000Å	212000-7830	\$1195.00
5µm	250x7.8	2000Å	212000-7825	\$1090.00
5µm	150x7.8	2000Å	212000-7815	\$900.00
5µm	50x7.8	2000Å	212000-7805	\$430.00
	(Guard column)			
5µm	300x4.6	2000Å	212000-4630	\$1075.00
5µm	250x4.6	2000Å	212000-4625	\$975.00
5µm	50x4.6	2000Å	212000-4605	\$425.00
5µm	30x4.6	2000Å	212000-4603	\$325.00
	(Guard column)			

* Sepax packs columns with the I.D. from 75 µm to 2 inches and the length from 2 cm to 60 cm. For the products not listed here, please contact Sepax Sales Department.